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AUTHOR	Bertoletti, Ana Carolina; Moraes, Marcia Cristina; da Rocha Costa, Antonio Carlos
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ABSTRACT

The SAGRES system is an educational environment built on the Web that facilitates the organization of visits to museums, presenting museum information bases in a way adapted to the user's characteristics (capacities and preferences). The system determines the group of links appropriate to the user(s) and shows them in a resultant HTML page. In addition, SAGRES enables cooperative learning by supporting interaction among users and also among members of groups of users. Users in SAGRES are aided by personal assistants that are software agents, whose purpose is to monitor the visitors' actions, helping them during the navigation. Considering studies in human-computer interaction and aiming to provide a friendlier interface for the SAGRES system, the agents have a graphical representation as animate characters. These characters improvise a group of behaviors similar to human behaviors (happiness, satisfaction and vibration), making the interaction more attractive. To evaluate the user's degree of satisfaction with the agents, a questionnaire was developed and some favorable results were obtained. This system was developed in the Museu de Ciencias e Tecnologia (MCT) at Pontificia Universidade Catolica do Rio Grande do Sul (PUCRS), Porto Alegre, Brazil. Includes seven figures and two tables. (Contains 13 references.) (Author)

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PAPERS
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Providing Personal Assistance In The SAGRES Virtual Museum

Ana Carolina Bertoletti, Museu de Ciências e Tecnologia -- PUCRS, Márcia Cristina Moraes, PPGCC-UFRGS, Antônio Carlos da Rocha Costa, Escola de Informática -- UCPEL, Brazil

Abstract

The SAGRES system is an educational environment built on the Web that facilitates the organization of visits to museums, presenting museum information bases in a way adapted to the user's characteristics (capacities and preferences). The system determines the group of links appropriate to the user(s) and shows them in a resultant HTML page. In addition, SAGRES enables cooperative learning by supporting interaction among users and also among members of groups of users.

Users in SAGRES are aided by personal assistants that are software agents, whose purpose is to monitor the visitors' actions, helping them during the navigation. Considering studies in human-computer interaction (Ball et al, 1997) (Koda, 1996) and aiming to provide a friendlier interface for the SAGRES system, the agents have a graphical representation as animate characters. These characters improvise a group of behaviours similar to human behaviours (happiness, satisfaction and vibration), making the interaction more attractive.

In order to evaluate the user's degree of satisfaction with the agents, we developed a questionnaire and obtained some favorable results. This system is developed in the Museu de Ciências e Tecnologia (MCT) at Pontificia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, Brazil.

Keywords: Virtual Museums, Software Agents, Personal Assistant and Evaluation of Systems.

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1. Introduction

Most virtual museums are sites that offer on-line learning resources, inviting the visitor to investigate and explore. The SAGRES system is a virtual museum that seeks cooperation between museum and schools, in order to create a new educational environment that provides continuous education, allowing access to information of the museum by the community at large. Due to the possibility of using the system as a distance-teaching tool, and to the diversity of the school population to be reached, SAGRES was conceived as a flexible and adaptive system, able to pay attention to the different needs and situations of its various visitors. Because presentation of information on the Web is achieved through hypermedia documents, success of virtual museums can be

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limited by a lack of initial training and by users getting 'lost' during navigation, due to the large number of links available.

In order to overcome these limitations, software agents were used to incorporate personal assistance to the SAGRES' users. These kinds of agents have been used for the development of a large number of applications. They can provide assistance to the user during some systems operations and can execute tasks on the user's behalf (Genesereth and Ketchpel, 1994). As personal assistants they can be responsible for helping in the navigation and operation of the system, overcoming the need for initial training. Besides, software agents are quite useful in analyzing and monitoring the users' actions. Considering this, we believe that agents can help in the system operation both at operational and interface level.

Many systems developed for the Internet have a concern about how to accommodate user needs and preferences and how to provide interfaces that are more comfortable and easy to manage. Some researchers are considering software agents as a good option, because they are adaptable, persistent, semi-autonomous (Maes et all., 1999) and can be represented through animate characters. There are studies that indicate that interaction with computers unavoidably evokes human social answers. People treat computers as humans even if the interface is not explicitly anthropomorphic. In this case, the social metaphor represented through the presence of animate characters (similar to real life people) has reduced anxiety associated with the use of computers.

In order to evaluate the degree of user satisfaction related to the agents, we conducted a study of agent evaluation methods and, based on this research, developed a questionnaire. We applied this questionnaire to partners of the Computer Club in the Museu de Ciências e Tecnologia (MCT) and we obtained some satisfactory results.

2. SAGRES -- A Virtual Museum

The SAGRES system (Bertoletti and Costa, 1999) is a virtual museum that seeks to form a partnership between museums and schools, and to build a new educational environment going beyond such partnership by providing information available in the museum to the whole community, through the Web. The system determines the information appropriate to the visitor(s) and shows it in a resultant HTML page.

The information available in the SAGRES is based on the physical structure of MCT. The subjects for consultation are arranged in the system in agreement with their actual location in the MCT exhibitions area, allowing to the visitor to find the experiments in a real visit.

Through the on-line exhibition visitors access the information of the physical museum. The use of such on-line information can happen in several ways (Lewis, 1997): in a set of activities coordinated by teachers in which students participate; in "halls of activities", i.e., series of activities with a central theme open to any visitor, and by individuals as a source for individual studies. In addition, SAGRES provides cooperative learning by supporting interaction among visitors and also among members of groups of visitors.

The system supports different groups of users:

- **A Visitor** accomplishes the interaction with the system individually. He is included in the system by a process of self-registering, where he is responsible for defining his profile, informing the system of his characteristics, capacities and preferences, in order to facilitate the construction of his model.
- **A Teacher** (generally identified as a school teacher whose student groups visit the museum) is responsible for the definition of the profile of the group. By a profile we understand the set of characteristics of the group; that is, the students' backgrounds and preferences, any particular subject being focused in the visit, and the activities. The teacher is also responsible for registering the students, as well as accompanying them and evaluating their performance during the visit, through reports delivered by the system.
- **A Student** is allowed to interchange ideas with colleagues in his group and to work on the activities and subjects determined by the teacher.

One advantage of SAGRES is that it allows visitors to plan their visits to the MCT in advance. Thus, when arriving at the museum, the visitor already knows where to find specific experiments. Later, in their homes, the visitors can get other information related to the experiments visited.

For teachers, SAGRES is a powerful tool to support teaching, because it works as a repository of information from which they can elaborate a library of activities (for example, questionnaires for tests) and share them with other teachers.

3. Integrating Personal Assistance in the SAGRES

Since information is presented on the Web through hypermedia documents, virtual museums are limited by the lack of initial training and by users getting lost during navigation, due to the large number of available links (Yamada et all., 1995). Therefore, software agents were used to incorporate personal assistance in the SAGRES system. As personal assistants they have the responsibility to help the visitors during interaction with the system. These agents are represented trough animated characters. According to Hayes-Roth (1998), the introduction of characters on the Internet introduces the sense that people are interacting with "real characters" in virtual worlds. This sense is intensified because characters simulate verbal and physical behaviours similar to humans, such as happiness, satisfaction and greeting. As people are social beings and interact instinctively with each other, the user's interaction with the interface becomes friendlier.

To support independence between the agents, SAGRES adopted a three-layer development model (Kirtland, 1999): presentation, business and data. The layers of data and business meet in the server. Data layer stores the SAGRES's databases and information related to the agents' execution scripts and repertoire of behaviours. The business layer implements the agents' functionalities. The presentation layer is located in the client and contains the SAGRES's HTML pages and agents' pages. This model is visualized in figure 1.

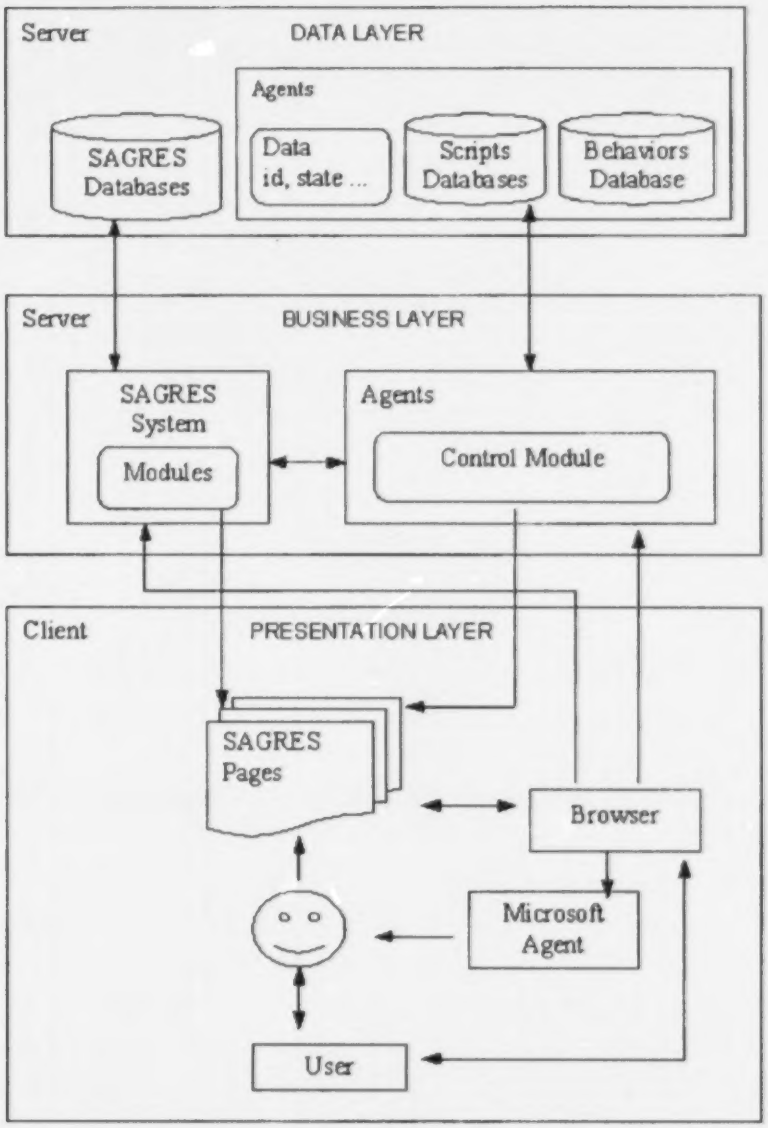

Figure 1: Agents and SAGRES System

Figure 1 shows that agents are structured into two main modules: internal representation (presented in the data and business layers) and interface (presented in the presentation layer). The internal representation module is divided into data and control. Data contains information about the agent such as agent identification, current agent state (idle, execution), script (name of the file that contains the execution's script of the agent), list of neighbours (name of the agents that it will be able to communicate to) and who is communicating (name of the agent that is communicating at the moment). This information is stored in a database. All information in data is updated, according to the process in the control module. The control module contains the personal

assistants' functions. Assistants have common knowledge about the world that is implicitly incorporated in the control module. The interface contains graphical representation of the agents that interact with visitors through the execution script incorporated in the HTML pages (Moraes et al., 1999a). An example of this script is illustrated in figure 2.

1. To present to the visitor *(to greet, to wave)*
2. To invite the visitor to make a visit to the museum *(to invite, to dance)*
3. To wait reply of the visitor *(to wait)*
   - 3.1 If visitor selects a consultation
     Looks to presentation agent for content *(researcher)*
     Demonstrates satisfaction *(satisfaction, vibration)*
   - 3.2 Else demonstrates reproof *(to refuse, to disapprove)*
     Stimulates visitor to make a visit *(to stimulate, to move)*
   - 3.3 If visitor requests mural's monitoring
     Monitors communication mural *(investigating, artist)*
   - 3.4 If visitor requests monitoring of document edition
     Monitors edition of document *(research, artist)*

Figure 2: Example of an execution script

This example shows that agent's actions are related to behaviours (physical and verbal). Each one of these behaviours has one to five possibilities of execution. In this way, the agents can improvise behaviours and different possibilities to execute the selected behaviour. This characteristic makes agents more flexible, life-like and believable, increasing the users' satisfaction related to the system operation as we can see in section 5.

4 Visualizing Personal Assistance in the SAGRES

In this section we are going to describe the SAGRES system, as it operates with personal assistants, by illustrating an example of the visitor' interaction. Figure 3 shows the main page of the system.

Figure 3: Main Page

After choosing the personal assistant option, the visitor provides his

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name and password (figure 4).

Figure 4: Logon Page

Based on the name and password information the system identifies the user's kind: visitor, student and/or teacher (figure 5).

Figure 5: Kind of User Page

After the user chooses the visitor module, the system loads his visitor's models (figure 6).

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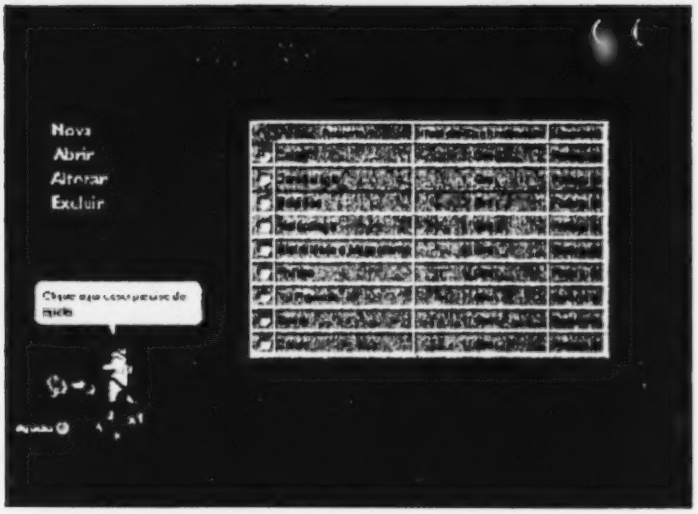

Figure 6: Consultation Options Page

After the user selects a subject, the system builds a presentation page where the user can see the documents about the selected subject and the link for the communication mural and document edition (figure 7).

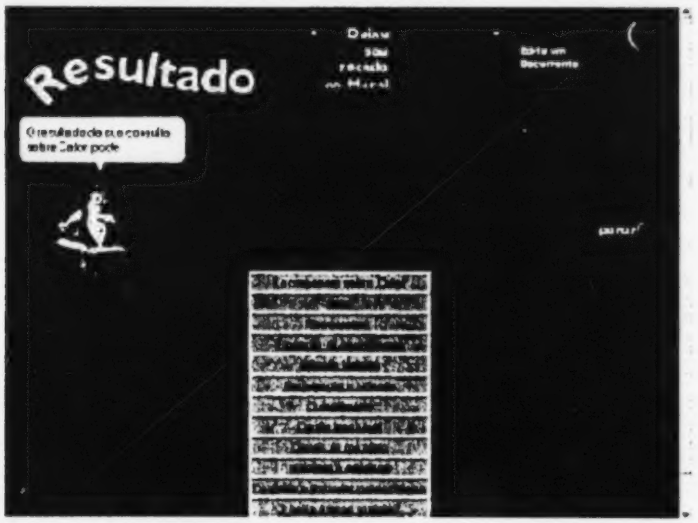

Figure 7: Information Presentation Page

In some pages there is a button related to the personal assistant, as we can see in figures 6 and 7. This button activates the assistant, so when the user needs help, he only has to click on that button. When the user wants to stop the explanation, he clicks on the button again. The user can activate the assistant when the button is green, and he can stop the assistant when the button is red. The explanation provided is in accordance with the pages' context, assistant actions and behaviours. When the button is not present, the assistant acts autonomously. This means that the assistant observes the user's actions and motivates and helps the user when necessary.

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5. Evaluation of Personal Assistance in the SAGRES System

In order to evaluate the user's satisfaction with the degree of personal assistance in the SAGRES system, we researched evaluation approaches for intelligent agents. Hayes-Roth and Doyle (1998) point out that works in intelligent agents inherit the evaluation approaches of Artificial Intelligence and other fields of Computer Science such as Human-Computer Interfaces. These approaches define the desirable qualities of systems. However, as personal assistants are intended to be more similar to people, traditional approaches should be adapted or modified. Hayes-Roth and Doyle (1998) present an adaptation of some important approaches for evaluation of animated characters. As personal assistants are represented through animated characters, these approaches can be applied. The approaches are:

- Reliable becomes variable: to be more human-like and believable the animate characters must display normal variability in their choice and manner of executing behaviours
- Predictable becomes idiosyncratic: animate characters must display roughly predictable patterns of behaviour, punctuated by interesting surprises
- Correct becomes appropriate: rather than behaving correctly, animate characters must behave appropriately, given the roles, their circumstances and their imperfect human-like natures
- Complete becomes effective: animate characters must function effectively, albeit sometimes incompletely, in the roles they play
- Efficient becomes interesting: animate characters must forego efficiency in their paths to goals in favour of paths that are intrinsically interesting
- Optimal becomes distinctively individual: it is important that animate characters be distinctive individuals whose behaviour surprises, delights or provokes us in ways that are unique

Considering the ideas presented by Hayes-Roth and Doyle (1998), we developed a questionnaire to evaluate characteristics related to the agents. The questions are illustrated in figure 8.

Each question has four alternatives as answers: bad, regular, good and very good. Weights of one to four, for concepts, were associated with answers, as illustrated in tables 1 and 2.

Questions	Bad	Regular	Good	Very Good
Did the personal assistant present different behaviors during the execution of particular tasks?				

Table 1: Questions Form

Concept	Weight
Bad	1
Regular	2
Good	3
Very Good	4

Table 2: Concepts ´ Weight

1-Did the personal assistant present different behaviors during the execution of particular tasks?
2- Did the personal assistant present appropriated behavior the each task?
3- Did the personal assistant was useful to help you in the system operation?
4- Did the personal assistant help you in a personalized way and did he encourage you to do your tasks?
5- Did the personal assistant disturb you during the presentation of information?
6- Did the personal assistant help you to concentrate on relevant information?
7- Did the information presented by the personal assistant are easy to understand?
8- Can ycu begin and interrupt the action of the personal assistant?
9- In the future, if you can choose the presentation with or without the personal assistant, which one you choose?

Figure 8: Agents Questionnaire

These questions follow the same format presented in table 1, except the last one, where the learner should choose between "with" or "without".

The average obtained in the questionnaire was 3.68. We verified that users favour the assistant's behaviours during the execution of tasks, obtaining an average 3.875. It's important to say that the other aspects obtained an average superior to 3.6. So, the assistant reached successfully the approaches proposed by Hayes-Roth and Doyle, displaying normal variability in their choice and manner of executing behaviours, and being attractive and interesting to users. Besides, the guide treats visitors in a personalized way, aiding and motivating them to accomplish tasks.

We can conclude that visitors are satisfied with the use of assistants. This satisfaction is explicit, because all the visitors answered *"with"* to the question *" In the future, if you can choose the presentation with or without the personal assistant, which one will you choose?"* In this way we verified that the personal assistant was an important aid to visitors during the operation of the system, executing its main functionality and serving as an incentive for future access to the system.

6. Conclusions

The SAGRES system makes the interactive museum of PUCRS remotely available to the public visitor, as well as contributing to the improvement of teaching and promoting the exchange of information among geographically distant visitors.

Personal assistants are used in SAGRES to assist visitors during a visit. They do this by helping visitors in the exploration of information and systems operation, through a friendly interface where visitors interact with animated characters whose behaviours are similar to human behaviours. A questionnaire administered to users of the virtual guide demonstrates that users prefer to operate the system with the virtual guide, because it facilitates navigation, offers personalized help and demonstrates interesting ways to interact with users, achieving its initial aims.

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